What is claimed is:

1. A method of manufacturing an illumination optical unit comprising a beam splitting element for splitting a beam emitted from a light source into a plurality of partial beams, a light focusing element for focusing the partial beams, and a polarization converting element for making the polarization directions of the partial beams uniform, the method comprising:

a first positioning step of adjusting a relative position on a predetermined optical path of the light focusing element and the polarization converting element on the basis of the shapes thereof, and fixing the position of the light focusing element and the polarization converting element;

a beam introducing step of introducing a beam on the light focusing element and the polarization converting element of which position is adjusted during the first positioning step and the beam splitting element disposed on the predetermined optical path;

an optical image forming step of transmitting the beam introduced by the beam introducing step into the light focusing element, the polarization converting element and the beam splitting element to form an optical image on a projection screen;

an optical image detecting step of detecting the optical image formed in the optical image forming step;

an illumination-area comparing step of calculating a comparison result of an illumination area of the optical image detected in the optical image detecting step with a designed illumination area;

an optimal-state determining step of determining whether the illumination area of the optical image is in the optimal state with respect to the designed illumination area or not on the basis of the comparison result from the illumination-area comparing step;

a beam-splitting-element position-adjusting step of adjusting the relative position of the beam splitting element with respect to the light focusing element and the polarization converting element on the basis of the comparison result calculated in the illumination area comparing step when the illumination area of the optical image is determined not in the optimal position in the optimal-state determining step; and

a second positioning step of fixing the position of the beam splitting element when the illumination area of the optical image is determined to be in the determined optimal state in the optimal-state determining step.

2. The method of manufacturing an illumination optical unit according to Claim 1, wherein a separating frame representing the shape of the designed illumination area is formed on the projection screen,

wherein the optical image on the projection screen and the separating frame are detected by an image pick-up device in the optical image detecting step,

wherein the illumination-area comparing step comprises:

an image fetching step of fetching an image detected in the optical image and the separating frame detected by the optical image detecting step as an image,

a brightness-value acquiring step of acquiring the brightness-value of the optical image in units of pixels by the optical image fetched in the image fetching step;

a scanning-line selecting step of selecting scanning lines set inside and outside the illumination area of the optical image;

a brightness-value adjusting-curve acquiring step of acquiring a brightness-value adjusting curve showing a change in brightness values according to pixel position on the scanning line selected in the scanning-line selecting step on the basis of the brightness-value acquired in the brightness-value acquiring step;

an approximate-straight-line calculating step of calculating an approximate straight line by linearly approximating a brightness-value adjusting section between a portion showing the outside of the illumination area of the optical image and a portion showing the inside of the illumination area based on the brightness-value adjusting curve acquired by the brightness-value adjusting-curve acquiring step;

a boundary-point acquiring step of acquiring boundary points of the illumination area of the optical image on the basis of the approximate straight line calculated in the approximate-straight-line calculating step; and

an illumination-margin calculating step of calculating an illumination margin of the illumination area of the optical image relative to the separating frame by comparing the positions of the boundary points acquired in the boundary-point acquiring step with the position of the separating frame.

3. The method of manufacturing an illumination optical unit according to Claim 1, wherein the designed illumination area is set to be substantially square,

wherein the scanning-line selecting step, the brightness-value adjusting-curve acquiring step, the approximate-straight-line calculating step and the boundary-point acquiring step are performed a plurality of times along the mutually opposing sides of the separating frame image, and

wherein, in the illumination-margin calculating step, the illumination margin M is calculated according to the following Expression (1), where Da represents a distance between opposing sides of the separating frame, and Ds represents a distance between a boundary point along one of the mutually opposing sides of the separating frame and another boundary point along the other side of the mutually opposing sides of the separating frame in a direction orthogonal to the mutually opposing sides.

$$M = (Ds - Da)/2 \quad (1)$$

4. The method of manufacturing an illumination optical unit according to Claim 1, wherein the illumination-area comparing step further comprises:

a separating-frame-image center-position calculating step of calculating an image center from the image fetched in the image fetching step;

an optical-image center-position calculating step of calculating an image center of the illumination area of the optical image from the positions of boundary points acquired in the boundary points acquiring step; and

an image-center deviation-amount calculating step of calculating the deviation amount of the center of the separating frame and the center of the illumination area of the optical image; and

wherein the optimal-state determining step determines that the illumination area of the optical image is in the optimal state when the illumination margin M calculated in the illumination-margin calculating step is at least the preset threshold value and when the deviation amount calculated in the image-center deviation-amount calculating step is the preset threshold value or below.

5. The method of manufacturing an illumination optical unit according to Claim 1, wherein the beam-splitting-element position-adjusting step comprises:

when an optical axis of the beams introduced in the beam introducing step is the Z axis and when two axes orthogonal to the Z axis and orthogonal to each other are the X axis and the Y axis, respectively, an X-axis position-adjusting step of moving the beam splitting element in the direction of the X axis;

a Y-axis position-adjusting step of moving the beam splitting element in the direction of the Y axis;

and an in-plane rotational-position-adjusting step of rotating the beam splitting element around the Z axis.

6. The method of manufacturing an illumination optical unit according to Claim 1,

wherein an uncured photo-curing adhesive is coated on the beam splitting element before the illumination area comparing step; and

wherein the photo-curing adhesive is irradiated with rays to cure the photo-curing adhesive to fix the beam splitting element in the second positioning process.

7. A method of manufacturing a projector comprising the method of manufacturing an illumination optical unit according to claim 1.

8. An illumination optical unit manufactured by the method of manufacturing an illumination optical unit according to Claim 1.

9. A projector comprising the illumination optical unit according to Claim 8.

10. An apparatus for manufacturing an illumination optical unit comprising a beam splitting element for splitting a beam emitted from a light source into a plurality of partial beams, a light focusing element for focusing the partial beams

and a polarization converting element for making polarization directions of the partial beams uniform, the apparatus comprising:

an element holding member for holding the light focusing element and the polarization converting element which are positioned and fixed by adjusting their relative position on the basis of the shapes thereof on a predetermined optical path;

a beam-splitting-element holding member for holding the beam splitting element disposed on the predetermined optical path;

a light source for introducing beams to the beam splitting element, the light focusing element, and the polarization converting element;

a projection screen onto which an optical image of the beams is projected through the beam splitting element, the light focusing element and the polarization converting element;

a position adjusting unit for adjusting the relative position of the beam splitting element with respect to the light focusing element and the polarization converting element;

a positioning and fixing unit for fixing the position of the beam splitting element;

an image pick-up element for picking-up an optical image formed on the projection screen;

an image fetcher for fetching the optical image picked-up by the image pick-up element as an image; and

an image processor for processing the image fetched by the image fetcher,

wherein the image processor comprises:

an illumination area comparing means for calculating a comparison result of an illumination area of the optical image with a designed illumination area based on the image fetched by the image fetcher; and

an optimal state determining means for determining whether the beam splitting element is located at the optimal position on the basis of the comparison result from the illumination area comparing means.